CLAIMS

What is claimed is:

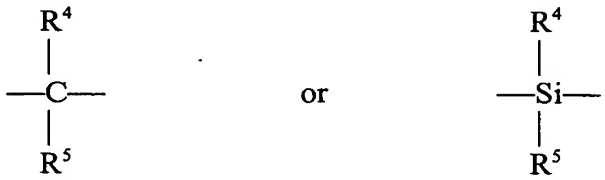
1. A poly(α-olefin) copolymer obtained from the polymerization of at least one α-olefin having from 2 to about 20 carbon atoms and at least one bulky olefin, the process comprising polymerizing the monomers in the presence of hydrogen and a catalytically effective amount of a catalyst comprising the product obtained by combining a metallocene procatalyst with a cocatalyst, the metallocene procatalyst being at least one compound of general formula:

$$(Cp^1R^1_m)R^3(Cp^2R^2_p)MX_q$$

wherein Cp^1 of ligand $(Cp^1R^1_m)$ and Cp^2 of ligand $(Cp^2R^2_p)$ are the same or different cyclopentadienyl rings, R^1 and R^2 each is, independently, hydrogen or a hydrocarbyl, halocarbyl, hydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid group containing up to about 20 carbon atoms, m is 0 to 5, p is 0 to 5 and two R^1 and/or R^2 substituents on adjacent carbon atoms of the cyclopentadienyl ring associated therewith can be joined together to form a ring fused to the cyclopentadienyl ring, the fused ring containing from 4 to about 20 carbon atoms, R^3 is a bridging group bridging Cp^1 and Cp^2, M is a transition metal having a valence of from 3 to 6, each X is a non-cyclopentadienyl ligand and is, independently, halogen or a hydrocarbyl, oxyhydrocarbyl, halocarbyl, hydrocarbyl-substituted organometalloid, oxyhydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid group containing up to about 20 carbon atoms, q is equal to the valence of M minus 2, the cocatalyst being an aluminoxane and it being provided that ligand $(Cp^1R^1_m)$ is different from ligand $(Cp^2R^2_p)$ and bridging

group R^3 contains at least two bulky groups.

2. The poly(α-olefin) of claim 1 wherein in the metallocene procatalyst, bridging group R^3 possesses the structure



in which groups R^4 and R^5 each, independently, is, or contains, a cyclic group of from 6 to about 20 carbon atoms, from 0 to 3 heteroatoms and hydrogen as the remaining atoms.

3. The poly(α-olefin) of claim 2 wherein in the metallocene procatalyst, the cyclic group is a cycloalkyl, heterocycloalkyl, cycloalkenyl, heterocycloalkenyl, aryl, heteroaryl, alkaryl, alkylheteroaryl, aralkyl or heteroaralkyl group.

4. The poly(α-olefin) of Claim 3 wherein in the metallocene procatalyst, ligand ($Cp^1R_m^1$) is unsubstituted cyclopentadienyl, ligand ($Cp^2R_p^2$) is substituted or unsubstituted indenyl or fluorenyl, M^1 is zirconium, R^4 and R^5 each is phenyl and each ligand X is chlorine.

5. The poly(α-olefin) of Claim 1 wherein the metallocene procatalyst is combined with hydrogen and the cocatalyst in any order thereof in the presence or absence of

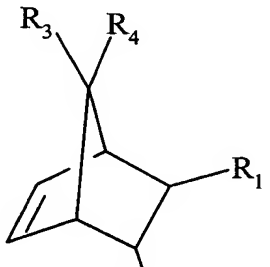
monomer.

6. The poly(α-olefin) of claim 2 wherein the metallocene procatalyst is combined with hydrogen and the cocatalyst in any order thereof in the presence or absence of monomer.

7. The poly(α-olefin) of claim 3 wherein the metallocene procatalyst is combined with hydrogen and the cocatalyst in any order thereof in the presence or absence of monomer.

8. The poly(α-olefin) of claim 4 wherein the metallocene procatalyst is combined with hydrogen and the cocatalyst in any order thereof in the presence or absence of monomer.

9. The poly(α-olefin) of claim 1 wherein the bulky olefin is selected from the group consisting of cyclic and polycyclic olefins of the structural formulae:



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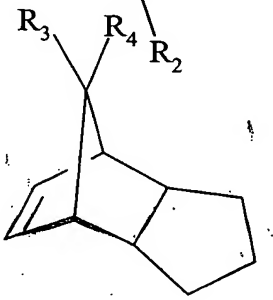

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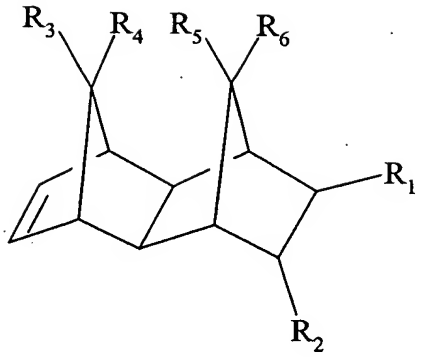

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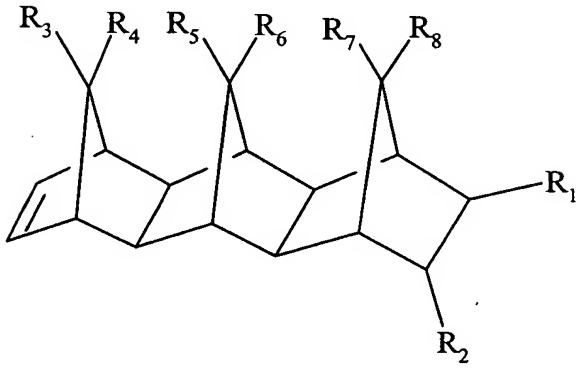

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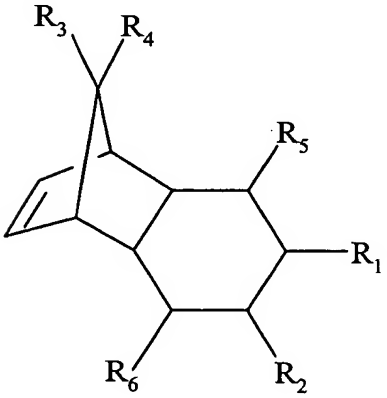

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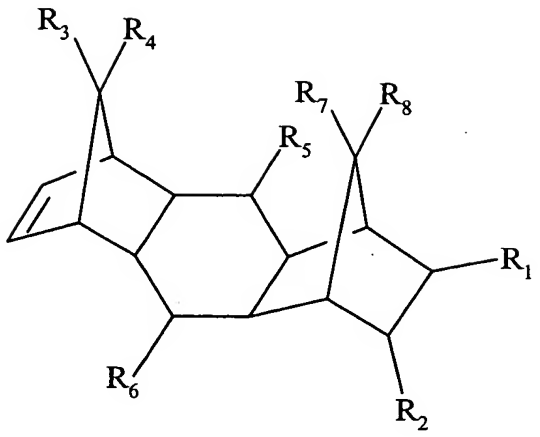


VI

wherein R_1, R_2, R_3, R_4, R_5, R_6, R_7, and R_8 are identical or different and are selected from the group consisting of hydrogen, C_6-C_{16} aryl moieties, and C_1-C_8 alkyl moieties, it being possible for identical radicals in the different formulae to have different meanings.

10. The poly(α-olefin) of claim 1 wherein the α-olefin is 1-decene and the bulky olefin is norbornene.

11. The poly(α-olefin) of claim 1 wherein polymerization is carried out under solution polymerization conditions.

12. The poly(α-olefin) of claim 1 wherein polymerization is carried out under slurry polymerization conditions.

13. The poly(α-olefin) of claim 1 possessing a M_w of from about 500 to about 80,000, a M_w/M_n of from about 1.0 to about 10, a Kv_{100} of from about 10 to about 10,000, an Iodine Number of from about 0.0 to about 10 and a T_g of below about -20° C and wherein the poly(α-olefin) is substantially amorphous.

14. The poly(α-olefin) of claim 13 possessing a M_w of from about 750 to about 60,000, a M_w/M_n of from about 1.5 to about 5, a Kv_{100} of from about 20 to about 7,500, an Iodine Number of from about 0.1 to about 5 and a T_g of below about -30° C and wherein the polyalphaolefin is substantially amorphous.

15. The poly(α-olefin) of claim 14 possessing a M_w of from about 1,000 to about 40,000, a M_w/M_n of from about 1.75 to about 4, a Kv_{100} of from about 25 to about 5,000, an Iodine Number of from about 0.2 to about 3 and a T_g of below about -40° C and wherein the poly(α-olefin) is substantially amorphous.

16. A lubricant composition comprising a lubricant and a viscosity-modifying amount of a poly(α-olefin) copolymer obtained from the polymerization of at least one α-olefin having from 2 to about 20 carbon atoms and at least one bulky olefin, the process comprising polymerizing the monomers in the presence of hydrogen and a catalytically effective amount of a catalyst comprising the product obtained by combining a metallocene

procatalyst with a cocatalyst, the metallocene procatalyst being at least one compound of general formula:

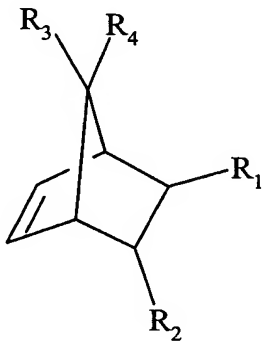
$$(Cp^1R^1_m)R^3(Cp^2R^2_p)MX_q$$

wherein Cp^1 of ligand $(Cp^1R^1_m)$ and Cp^2 of ligand $(Cp^2R^2_p)$ are the same or different cyclopentadienyl rings, R^1 and R^2 each is, independently, hydrogen or a hydrocarbyl, halocarbyl, hydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid group containing up to about 20 carbon atoms, m is 0 to 5, p is 0 to 5 and two R^1 and/or R^2 substituents on adjacent carbon atoms of the cyclopentadienyl ring associated therewith can be joined together to form a ring fused to the cyclopentadienyl ring, the fused ring containing from 4 to about 20 carbon atoms, R^3 is a bridging group bridging Cp^1 and Cp^2, M is a transition metal having a valence of from 3 to 6, each X is a non-cyclopentadienyl ligand and is, independently, halogen or a hydrocarbyl, oxyhydrocarbyl, halocarbyl, hydrocarbyl-substituted organometalloid, oxyhydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid group containing up to about 20 carbon atoms, q is equal to the valence of M minus 2, the cocatalyst being an aluminoxane and it being provided that ligand $(Cp^1R^1_m)$ is different from ligand $(Cp^2R^2_p)$ and bridging group R^3 contains at least two bulky groups.

17. The lubricant composition of claim 16 wherein in the metallocene procatalyst, ligand $(Cp^1R_m^1)$ is unsubstituted cyclopentadienyl, ligand $(Cp^2R_p^2)$ is substituted or unsubstituted indenyl or fluorenyl, M^1 is zirconium, R^4 and R^5 each is phenyl and each ligand

X is chlorine.

18. The lubricant composition of claim 16 wherein the bulky olefin is selected from the group consisting of cyclic and polycyclic olefins of the structural formulae:



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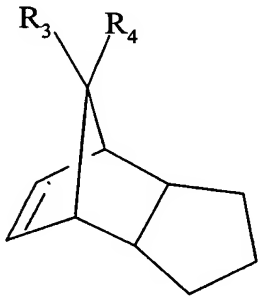

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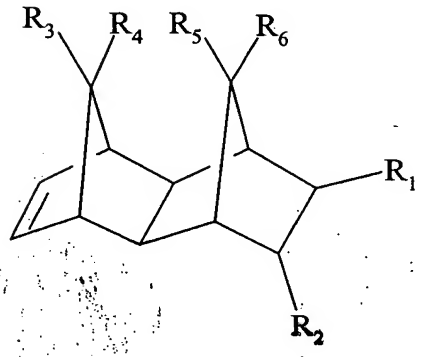

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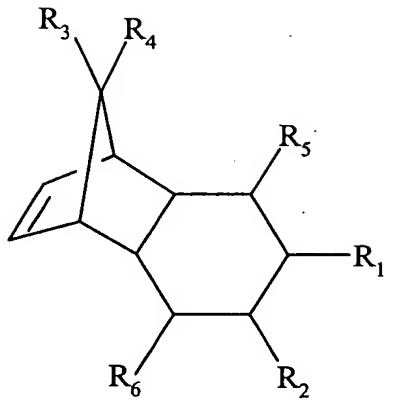

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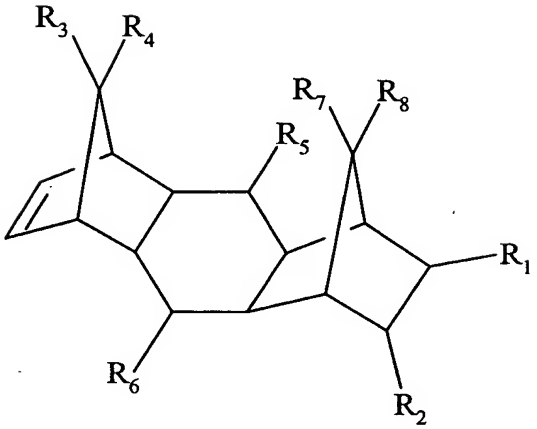

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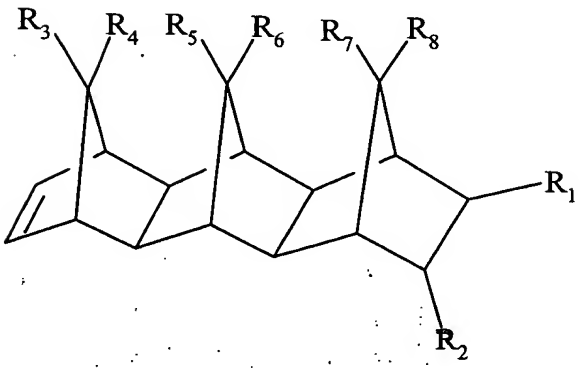


IV

wherein R_1, R_2, R_3, R_4, R_5, R_6, R_7, and R_8 are identical or different and are selected from the group consisting of hydrogen, C_6-C_{16} aryl moieties, and C_1-C_8 alkyl moieties, it being possible for identical radicals in the different formulae to have different meanings.

19. The lubricant composition of claim 16 wherein the α-olefin is 1-decene and the bulky olefin is norbornene.

20. The lubricant composition of claim 16 wherein polymerization is carried out under slurry polymerization conditions.

21. The lubricant composition of claim 16 wherein the poly(α-olefin) possesses a M_w of from about 500 to about 80,000, a M_w/M_n of from about 1.0 to about 10, a Kv_{100} of from about 10 to about 10,000, an Iodine Number of from about 0.0 to about 10 and a T_g of below about -20° C and wherein the poly(α-olefin) is substantially amorphous.

22. The lubricant composition of claim 16 wherein the poly(α-olefin) possesses a M_w of from about 750 to about 60,000, a M_w/M_n of from about 1.5 to about 5, a Kv_{100} of from about 20 to about 7,500, an Iodine Number of from about 0.1 to about 5 and a T_g of below about -30° C and wherein the poly(α-olefin) is substantially amorphous.

23. A method for improving the viscosity index of a lubricant composition

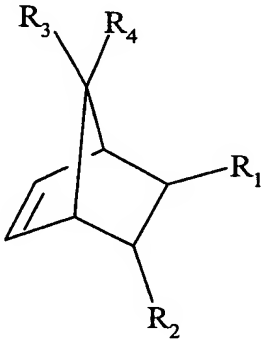
comprising adding to the composition a viscosity-modifying amount of a poly(α-olefin) copolymer obtained from the polymerization of at least one α-olefin having from 2 to about 20 carbon atoms and at least one bulky olefin, the process comprising polymerizing the monomers in the presence of hydrogen and a catalytically effective amount of a catalyst comprising the product obtained by combining a metallocene procatalyst with a cocatalyst, the metallocene procatalyst being at least one compound of general formula:

$$(Cp^1R^1_m)R^3(Cp^2R^2_p)MX_q$$

wherein Cp^1 of ligand $(Cp^1R^1_m)$ and Cp^2 of ligand $(Cp^2R^2_p)$ are the same or different cyclopentadienyl rings, R^1 and R^2 each is, independently, hydrogen or a hydrocarbyl, halocarbyl, hydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid group containing up to about 20 carbon atoms, m is 0 to 5, p is 0 to 5 and two R^1 and/or R^2 substituents on adjacent carbon atoms of the cyclopentadienyl ring associated therewith can be joined together to form a ring fused to the cyclopentadienyl ring, the fused ring containing from 4 to about 20 carbon atoms, R^3 is a bridging group bridging Cp^1 and Cp^2, M is a transition metal having a valence of from 3 to 6, each X is a non-cyclopentadienyl ligand and is, independently, halogen or a hydrocarbyl, oxyhydrocarbyl, halocarbyl, hydrocarbyl-substituted organometalloid, oxyhydrocarbyl-substituted organometalloid or halocarbyl-substituted organometalloid group containing up to about 20 carbon atoms, q is equal to the valence of M minus 2, the cocatalyst being an aluminoxane and it being provided that ligand $(Cp^1R^1_m)$ is different from ligand $(Cp^2R^2_p)$ and bridging group R^3 contains at least two bulky groups.

24. The method of claim 23 wherein in the metallocene procatalyst, ligand ($Cp^1R_m^1$) is unsubstituted cyclopentadienyl, ligand ($Cp^2R_p^2$) is substituted or unsubstituted indenyl or fluorenyl, M^1 is zirconium, R^4 and R^5 each is phenyl and each ligand X is chlorine.

25. The method of claim 23 wherein the bulky olefin is selected from the group consisti1ng of cyclic and polycyclic olefins of the structural formulae:



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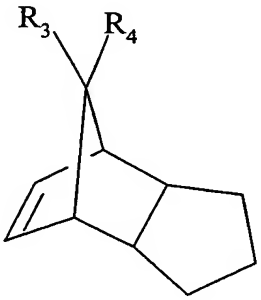

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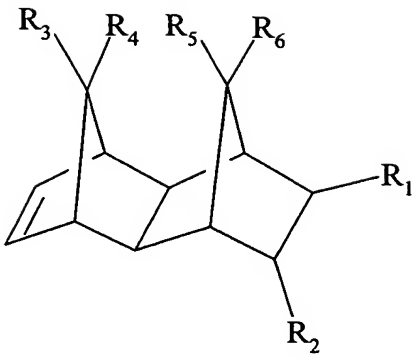

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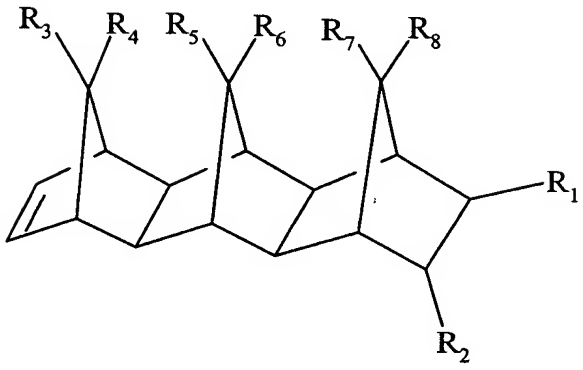

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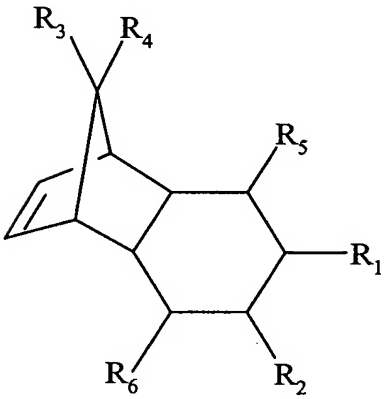

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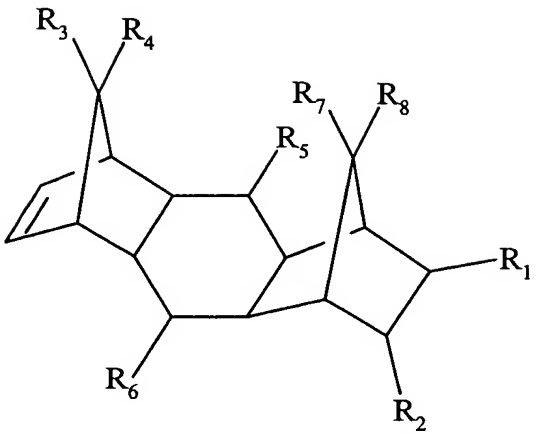

VI

wherein R_1, R_2, R_3, R_4, R_5, R_6, R_7, and R_8 are identical or different and are selected from the group consisting of hydrogen, C_6-C_{16} aryl moieties, and C_1-C_8 alkyl moieties, it being possible for identical radicals in the different formulae to have different meanings.

26. The method of claim 23 wherein the α-olefin is 1-decene and the bulky olefin is norbornene.

27. The method of claim 23 wherein polymerization is carried out under slurry polymerization conditions.

28. The method of claim 23 wherein the poly(α-olefin) possesses a M_w of from about 500 to about 80,000, a M_w/M_n of from about 1.0 to about 10, a Kv_{100} of from about 10 to about 10,000, an Iodine Number of from about 0.0 to about 10 and a T_g of below about -

20° C and wherein the poly(α-olefin) is substantially amorphous.

29. The method of claim 23 wherein the poly(α-olefin) possesses a M_w of from about 750 to about 60,000, a M_w/M_n of from about 1.5 to about 5, a Kv_{100} of from about 20 to about 7,500, an Iodine Number of from about 0.1 to about 5 and a T_g of below about -30° C and wherein the polyalphaolefin is substantially amorphous.